



US006177921B1

(12) **United States Patent**  
**Comiskey et al.**

(10) **Patent No.:** **US 6,177,921 B1**  
(45) **Date of Patent:** **Jan. 23, 2001**

(54) **PRINTABLE ELECTRODE STRUCTURES  
FOR DISPLAYS**

(75) Inventors: **Barrett Comiskey**, Cambridge; **Paul Drzaic**, Lexington, both of MA (US)

(73) Assignee: **E Ink Corporation**, Cambridge, MA (US)

(\*) Notice: Under 35 U.S.C. 154(b), the term of this patent shall be extended for 0 days.

(21) Appl. No.: **09/141,103**

(22) Filed: **Aug. 27, 1998**

**Related U.S. Application Data**

(60) Provisional application No. 60/057,133, filed on Aug. 28, 1997, provisional application No. 60/057,716, filed on Aug. 28, 1997, provisional application No. 60/057,122, filed on Aug. 28, 1997, provisional application No. 60/057,798, filed on Aug. 28, 1997, provisional application No. 60/057,163, filed on Aug. 28, 1997, provisional application No. 60/059,358, filed on Sep. 19, 1997, provisional application No. 60/065,630, filed on Nov. 18, 1997, provisional application No. 60/066,245, filed on Nov. 20, 1997, provisional application No. 60/066,246, filed on Nov. 20, 1997, provisional application No. 60/066,115, filed on Nov. 21, 1997, provisional application No. 60/066,334, filed on Nov. 21, 1997, provisional application No. 60/066,418, filed on Nov. 24, 1997, provisional application No. 60/070,940, filed on Jan. 9, 1998, provisional application No. 60/071,371, filed on Jan. 15, 1998, provisional application No. 60/072,390, filed on Jan. 9, 1998, provisional application No. 60/070,939, filed on Jan. 9, 1998, provisional application No. 60/070,935, filed on Jan. 9, 1998, provisional application No. 60/074,454, filed on Feb. 12, 1998, provisional application No. 60/076,955, filed on Mar. 5, 1998, provisional application No. 60/076,959, filed on Mar. 5, 1998, provisional application No. 60/076,957, filed on Mar. 5, 1998, provisional application No. 60/076,956, filed on Mar. 5, 1998, provisional application No. 60/076,978, filed on Mar. 5, 1998, provisional application No. 60/078,363, filed on Mar. 18, 1998, provisional application No. 60/081,374, filed on Apr. 10, 1998, provisional application No. 60/081,362, filed on Apr. 10, 1998, provisional application No. 60/085,096, filed on May 12, 1998, provisional application No. 60/090,222, filed on Jun. 22, 1998, provisional application No. 60/092,046, filed on Jul. 8, 1998, provisional application No. 60/092,050, filed on Jul. 8, 1998, and provisional application No. 60/092,742, filed on Jul. 14, 1998.

(51) **Int. Cl.<sup>7</sup>** ..... **G09G 3/34; G02B 26/00**  
(52) **U.S. Cl.** ..... **345/107; 359/296; 359/297**  
(58) **Field of Search** ..... **345/107; 359/296, 359/297**

(56) **References Cited**

**U.S. PATENT DOCUMENTS**

3,806,893 4/1974 Ohnishi et al. .... 340/173  
3,850,627 11/1974 Wells et al. .... 96/1.3

(List continued on next page.)

**FOREIGN PATENT DOCUMENTS**

4431441C1 2/1996 (DE) ..... H02J/13/00  
19500694A1 8/1996 (DE) ..... G09F/9/33

(List continued on next page.)

**OTHER PUBLICATIONS**

W.S. Quon, "Multilevel Voltage Select (MLVS): A Novel Technique to X-Y Address an Electrophoretic Image Display" *Trans. On Electron Devices* ED24(8):1121-1123(1977).

(List continued on next page.)

*Primary Examiner*—Matthew Luu

*Assistant Examiner*—Anthony J Blackman

(74) *Attorney, Agent, or Firm*—Testa, Hurwitz & Thibault, LLP

(57) **ABSTRACT**

Novel addressing schemes for controlling electronically addressable displays include a scheme for rear-addressing displays, which allows for in-plane switching of the display material. Other schemes include a rear-addressing scheme which uses a retroreflecting surface to enable greater viewing angle and contrast. Another scheme includes an electrode structure that facilitates manufacture and control of a color display. Another electrode structure facilitates addressing a display using an electrostatic stylus. Methods of using the disclosed electrode structures are also disclosed. Another scheme includes devices combining display materials with silicon transistor addressing structures.

**15 Claims, 8 Drawing Sheets**

